Vittaria Gametophytes Discovered in a New Physiographic Province

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Since their recognition over 20 years ago, knowledge of the distribution and taxonomic affinities of the perennial *Vittaria* gametophytes found in the eastern United States has expanded greatly. Once thought to be extremely rare and local, they now are known to be common in selected habitats over a broad region of the Appalachians. Farrar (1978) summarized the history of this taxon and presented a map of its distribution as then understood. *Vittaria* gametophytes have been discovered in the unglaciated Appalachian Plateau, Blue Ridge, Ridge and Valley, and Upland Piedmont provinces, all uplifted bedrock areas which presumably have been in continuous existence since Tertiary times. Farrar et al. (1983) discussed these recent finds and reported the gametophytes from sites in Ohio and Pennsylvania near the limits of Pleistocene glaciation. This article describes the presence of *Vittaria* gametophytes beyond these limits. This unusual fern now has been discovered on the glaciated Appalachian Plateau nearly 90 km north of the southern limit of Wisconsinan glaciation. This also is the first report of *Vittaria* gametophytes from the watershed of the Great Lakes.

The *Vittaria* gametophytes were found 10 June 1982 on Little Mountain, Geauga and Lake counties, Ohio, on property of the Holden Arboretum, Mentor, Ohio (*Fig. 1*). Accompanying the author were Brian Parsons and Thomas Yates, field naturalists of the Arboretum, and Robert McCance of the Division of Natural Areas and Preserves, Ohio Department of Natural Resources. To say that we were surprised by this discovery would be an understatement. Only a small collection was made at this time (*Cusick 21673*, ISC). The author revisited the site on 24 August, searching more thoroughly for gametophytes, and again preparing a voucher (*Cusick 22000*, OS). Colonies of *Vittaria* were found to occur discontinuously in a linear band over approximately 0.5 km of the slope of Little Mountain. Identity of the gametophytes was verified by Dr. Donald R. Farrar of Iowa State University.

The site of this discovery is an extraordinary area not at all typical of glaciated Ohio and a habitat highly suitable for the growth of *Vittaria*. Little Mountain is at the extreme edge of the glaciated Appalachian Plateau, being one of the localized bedrock exposures that mark the escarpment between the elevated Plateau and the Lake Plains of the Central Interior Lowlands province. The mountain is shaped roughly like a dumbbell, oriented north to south, with knobs at either end. The northern knob rises to 380 m, the southern knob to 386 m. Between these summits is a flattened saddle only slightly lower in elevation. The northern knob lies partly in Concord Township, Lake County, while the bulk of the mountain is in Chardon Township, Geauga County. The shoreline of Lake Erie is only 6.5 km north of the mountain. The approximate mean elevation of the lake at that point is 174 m. Thus,

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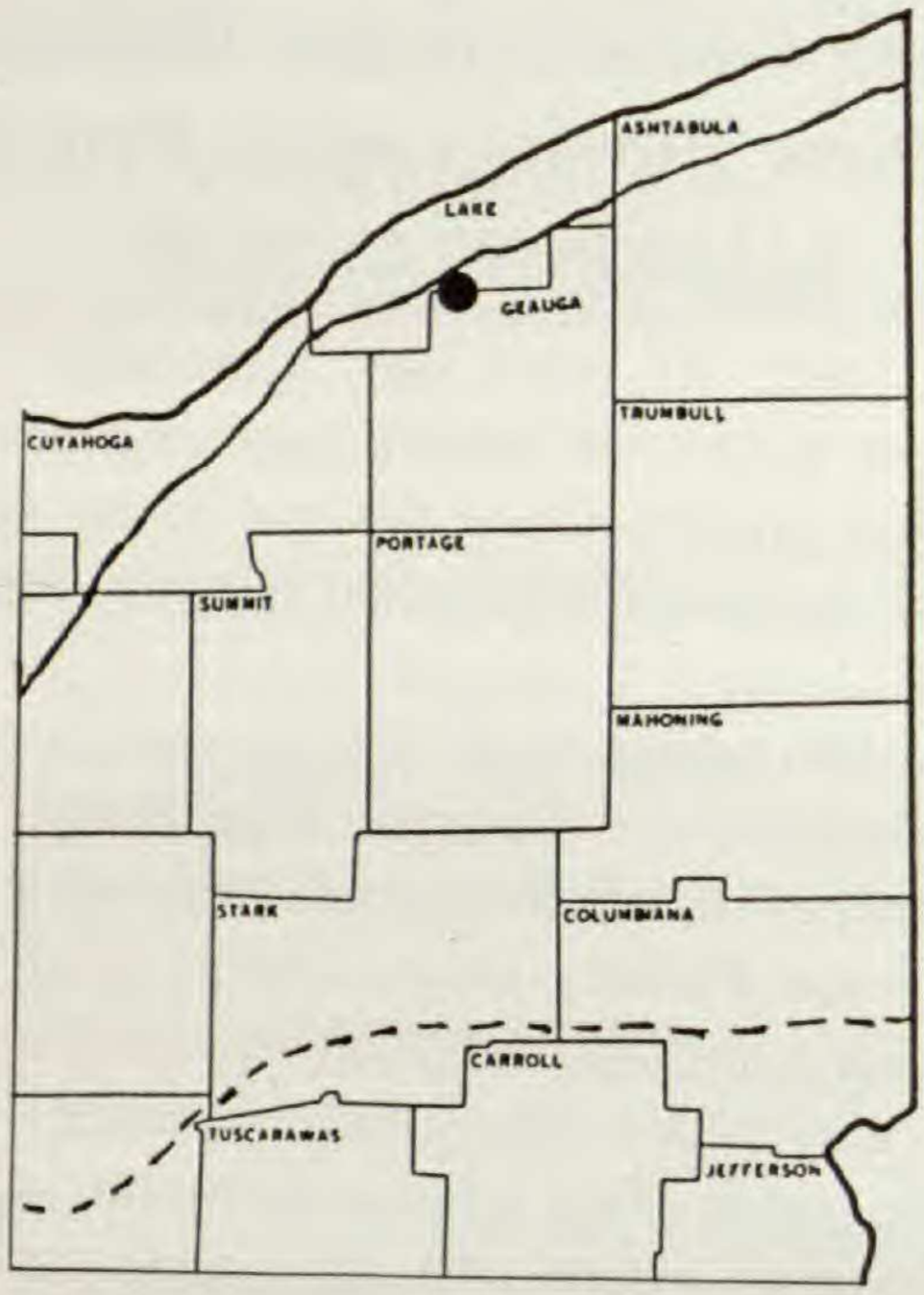

FIG. 1. The northeastern quarter of Ohio. Solid line indicates the northern limit of the glaciated Appalachian Plateau; dashed line, the southern limit of Wisconsinan glaciation. Solid dot is location of Little Mountain.

there is a difference in elevation of 206 m between the mountain and Lake Erie (U.S. Geological Survey, 1970.)

This dramatic change in elevation between lake and summit has a significant effect on local weather patterns. Winds moving south across Lake Erie pick up moisture which is quickly lost once this escarpment is reached. In the lee of these summits, then, is the locally-famous "snow belt" of northeastern Ohio. This local phenomenon is clearly shown on the snowfall map in Gordon (1969) on which the site of Little Mountain may be seen in the pattern of isopleths. Snowfall in the Little Mountain region averages nearly 3 m yearly, far in excess of Ohio's annual average snowfall of about 1 m.

The summits of Little Mountain and the other elevations at the edge of the glaciated Appalachian Plateau in Ohio are capped by the Sharon Conglomerate formation of the Pottsville group of the Pennsylvanian System of sedimentary rocks. Throughout northeastern Ohio, the Sharon Conglomerate is noted for the formation of massive cliff faces, rock shelters, and slump blocks (Rau, 1970). The designation "conglomerate" is somewhat misleading. Pebble size is extremely variable, ranging from about 1 mm to 5 cm, and occasionally even larger (Heimlich et al., 1970). There may be abrupt lateral gradation in pebble size, a feature strikingly evident on Little Mountain. Coogan et al. (1974) map two prominent belts of Sharon Conglomerate notable for large pebbles, one belt of which terminates at Little Mountain. About 90% of the pebbles are milky quartz, with limonite as the usual cement. Differential weathering of this cement results often in honeycomb patterns in the cliff faces (Heimlich et al., 1970).

At the base of the Sharon formation lies a major disconformity with the Meadville Shale of the Cuyahoga group of Mississippian age sediments. This disconformity is responsible for two phenomena which contribute to the habitat supporting the populations of *Vittaria,* namely, the origination of springs and the formation of slump blocks. The Sharon Conglomerate is highly permeable, whereas the underlying shale is relatively impervious. This disconformity, then, is marked by a zone of seeps and springs (Heimlich et al., 1970; Rau, 1970). The jointed conglomerate tends to slip along this lubricated shale surface, splitting the rock, which slowly moves downslope. On Little Mountain this joint-controlled slippage forms a picturesque and complex system of blocks and chasms ranging from 1 to 3 m wide, occasionally narrower, 10 to 15 m deep, and often as long as 50 m (Aronson, 1974).

The springs which flow from the disconformity on Little Mountain are exceptional in that they average 8–9°C year-round (Parsons, pers. comm.). This cold temperature allied with the depth and narrowness of the fissures on the mountain permits snow and ice to persist long into the warmer months. The writer noted the remains of ice on 10 June 1982. Even in mid-summer one's breath condenses before one's face while walking through the chasms on the mountainside. The environment within the crevasses of Little Mountain conforms in every particular to the ecological requirements of *Vittaria* as outlined by Farrar (1978, p. 4): "a low light intensity of 100 ft-c or less, relatively high humidity, and protection from temperature extremes . . . overhanging rock outcrops, dense forest canopy, and nearness to running water."

Floristically, Little Mountain is a part of the White Pine–Hemlock–Northern Hardwoods community (Braun, 1950), a forest association of very limited occurrence in Ohio. The first botanist to visit the mountain may have been John L. Riddell, who collected several species from this "pine-clad, rubblestone knob" (Riddell, 1836, p. 567). Read (1873a, b) listed the major forest trees of the mountain, particularly noting the Hemlock (*Tsuga canadensis* (L.) Carr.) and White Pine (*Pinus strobus* L.) on the northern end of the mountain, the extensive growth of American Chestnut (*Castanea dentata* (Marsh.) Borkh.) throughout the summit, and "Rock Oak" (*Quercus prinus* L.) on the southern knob. All these species are yet extant on the mountain, although the chestnut is represented only by fallen, dead trees and root sprouts. Ferris (1887) presented an extensive list of vascular species for the mountain. While his list contains some obvious inaccuracies, it also provides further evidence that most of the herbaceous and woody species found on Little Mountain in the past still grow there today and that the original vegetation conformed to Braun's concept of the White Pine–Hemlock–Northern Hardwoods community.

In most of its known range, the *Vittaria* gametophyte seems associated with the Mixed Mesophytic forest as defined by Braun (1950). This is the case, for instance, with other known Ohio populations. However, the Warren County, Pennsylvania station (Farrar et al., 1983), like Little Mountain, is within the White Pine–Hemlock–Northern Hardwoods floristic province. The occurrence of *Vittaria* gametophytes probably is more closely related to appropriate physical and geological setting than to floristic province.

Little Mountain was a prominent landmark to the first settlers of northeastern Ohio. As early as 1831, a hotel was built on the mountaintop, and within the following 50 years Little Mountain became a celebrated resort. At least three hotels were built on the summit, together with a complex of summer cottages, gazebos, churches, schoolhouses, and bowling alleys. The largest and best-known of the hotels, the Pinecrest, built in the late 1880's, featured a Western Union telegraph line and a post office. The cool springs also induced developers to advertise water cures for "invalids." Guests clambered through the chasms on sweltering summer days, enjoyed the cool breezes through the white pines, and gazed at the dramatic view of Lake Erie from the northern knob. It was fashionable to carve one's name on the conglomerate in the "Devil's Kitchen," as one large grotto was dubbed. Many of these graffiti are still legible today, a sort of permanent guest register. The resort era ended by 1920 and the Pinecrest hotel was torn down in 1941. Little Mountain ceased to be the playground of the public and instead became the private preserve of the Little Mountain Club, an elite group of wealthy Clevelanders (Ahlstrom, 1961; Ferris, 1887). The mountain could then recover from the years of wanton vandalism. The present composition of the vegetation and the beautiful stand of mature White Pine are tributes to the ability of plant communities to survive and recover from severe disturbance. Other than the graffiti on the rocks, now largely cloaked by bryophytes, the most notable evidence of the former resort is the abundance of *Vinca minor* L. on the mountaintop.

Little of the disturbance described above would have had a direct effect on the *Vittaria* population. However, it is difficult to be certain how common or widespread the gametophytes might have been prior to the time of the hotels. Today, the *Vittaria*, although occurring over a considerable linear area of the mountainside, grows in isolated pockets, often only a few square cm in extent, on the walls of the darkest and narrowest of the crevasses formed in the Sharon Conglomerate. The plants do not form great mats of vegetation covering entire rock faces as described by Farrar (1978) or as observed by the author in the Hocking Hills of southeastern Ohio. An occasional colony of the gametophytes occurs in the cast left by the fall of a particularly large quartz pebble. Most often the plants grow in recesses or narrow clefts formed in zones of finer pebble size. The plants definitely are less frequent in the areas of coarser pebbles.

Since this population of *Vittaria* gametophytes is the first reported from glaciated regions, it is interesting to speculate on the mode of introduction of the species to Little Mountain. In this regard, it must be clearly stated that Little Mountain was not a nunatak. Read (1873b) found granite boulders on the mountaintop and White (1980, 1982) maps thin layers of Hiram Till of Wisconsinan age over even the highest summits of the limits of the Appalachian Plateau in Ohio. Clearly, Little Mountain was not a refugium on which individuals of *Vittaria* could have survived glaciation.

The means of dispersal of this species, even in the heart of its range, is little understood. Although *Vittaria* gametophytes prolifically produce vegetative gemmae, there seems to be no obvious mechanical means for transporting these gemmae across the 90 km gap between Little Mountain and the nearest limit of the

Wisconsinan ice. It seems unlikely that the few-celled gemmae could survive wind-borne dispersal over such a distance without fatal desiccation. Also, it is difficult to understand how wind currents can lift these gemmae from the sheltered grottos and canyons in which they occur and convey them into the upper air. A possibility, which seems highly unlikely at least to this writer, is that the plants were introduced by an animal or human visitor who had accidentally picked up the gemmae in southeastern Ohio only a short time before.

Both Farrar and this writer have found *Vittaria* gametophytes at the limit of Wisconsinan glaciation in Fairfield County, Ohio, yet have failed to locate the species in similar habitats and on the same rock strata in areas only a few kilometers beyond the glacial boundary in other Ohio counties. Farrar's two western Pennsylvania stations for *Vittaria* gametophytes are located in Lawrence and Warren counties. The Lawrence County site is about 80 km southeast of Little Mountain and is located just north of the Illinoian glacial limit and south of the Wisconsinan boundary. The Warren County population is about 160 km east-northeast of Little Mountain and is directly south of the Illinoian limit. At present, the Warren County station is the northernmost known occurrence of these gametophytes (Farrar et al., 1983).

It is probably useless to speculate overmuch on the origin of the Little Mountain population of *Vittaria* until other, similar sites on the glaciated Appalachian Plateau of Ohio and nearby states are examined for this species. Appropriate habitats elsewhere in glaciated regions may well harbor populations of this gametophyte. Indeed, the perennial gametophyte of an as yet unknown species of *Trichomanes* has been found on the glaciated Appalachian Plateau from central Ohio to New Hampshire (Farrar et al., 1983; McAlpin et al., 1978). Perhaps this find of *Vittaria* should not come as such a surprise after all.

In glaciated Ohio, suitable habitats are very limited in extent and highly disturbed. If the case of Little Mountain is considered, however, disturbance which may have extirpated other types of vegetation may not have had so severe an effect on *Vittaria*. As of this writing, *Vittaria* gametophytes have not been found elsewhere in glaciated Ohio. But much field work remains to be done before any firm conclusions can be reached as to the true distribution of the gametophytes, either nationally or statewide. This find opens new realms for fern enthusiasts to explore.

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